Strategic Surveys for *Martes* Populations In Northwestern California:

Mendocino National Forest

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Summary

We used a combination of historical trapping locations, filtered sightings, and potentially suitable habitat to identify the most likely locations on the Mendocino National forest that could support populations of American martens (*Martes americana*). As a secondary objective, we surveyed as many areas in the vicinity of the marten survey locations for the presence of fishers (*Martes pennanti*). In each target area we established as many 4-mi^2 sample units, consisting of 6 track plate stations runs for 14 consecutive days, as necessary to saturate them. During the period from 8 July to 26 September 2006, 35 sample units and 7 opportunistic stations in their vicinities were completed. Seventeen species (16 mammals, 1 reptile) were detected at track plate stations. No martens were detected at any stations and they have apparently been extirpated from the high elevation sites in the vicinity of Lake Pillsbury where most historical records of their occurrence exist. Fishers were the most frequently detected carnivore and were detected at 20 (54%) of the sample units and at a total of 26 of 201 (13%) individual stations. Overall fishers appear to be distributed throughout the portions of their historical range on the Mendocino National Forest that were included in the geographic extent of our surveys.

Introduction

Background

The American marten (*Martes americana*) and fisher (*M. pennanti*) are carnivorous mammals that occur in boreal and coastal forests of North America (Powell et al. 2003). In the Pacific states the American marten has remained well distributed in the interior high-elevation portions of its range but has dramatically declined in its distribution in coastal portions of its range (Zielinski et al. 2001). The greatest decline has occurred in the historical range of the Humboldt marten (*M. a. humboldtensis*) in coastal northwestern California. The Humboldt marten is listed as a Species of Special Concern by the California Department of Fish and Game (CDFG) and a Sensitive Species by the U.S. Forest Service (USFS). The fisher has been extirpated from Washington, and is represented by only 2 native, but disjunct, populations in the southern Sierra Nevada and in northwest California and extreme southwest Oregon. In 2000 the fisher was petitioned for listing as threatened or endangered under the Endangered Species Act in the Pacific States; the petition was found to be 'warranted but precluded' in 2004 by the U. S. Fish and Wildlife Service (USFWS 2004).

The Mendocino National Forest (MNF) includes portions of the historical ranges of the Humboldt marten (Stone 1904, Twinning and Hensley 1947, Hemphill 1952) and fisher (Grinnell et al. 1937). There has been little survey effort to determine the contemporary distribution of the marten or fisher on the MNF, representing one of the largest remaining survey gaps in their respective historical ranges in northern California. Historical information on the occurrence of the marten on the MNF is concentrated in the largely true fir (*Abies* sp.) forests on the mountains in the vicinity of Pillsbury reservoir

(Stone 1904, Hemphill 1952). The historical range of the fisher includes the majority of the MNF (Grinnell et al. 1937).

The primary goal of this project was to conduct strategically located surveys in the few remaining areas that can potentially support additional marten populations on the MNF. The secondary goal was to survey additional areas with suitable habitat for the presence of fishers.

Study Area

The study area is approximately 2800 km^2 and was located on the MNF, including portions of Mendocino, Trinity, Tehama, Glenn, Colusa, and Lake counties (Figure 1). Elevations range from 230 - 2500 m within the MNF. Annual temperatures at higher elevations range from an average of -2°C in winter to an average of 24°C in summer. Winters are cold and wet, with snow typically accumulating above 1500 m, and summers are extremely dry and warm. Average rainfall is 175 cm per year. The MNF is dominated by a mixture of conifer-dominated and conifer-hardwood dominated forest types with oak woodland and chaparral habitats becoming dominant at lower elevations and towards the southern end of the MNF. Mid-elevation conifer and conifer-hardwood forests are dominated by Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*), with black oak (*Quercus kellogii*) and canyon live oak (*Quercus chrysolepis*), grading into white fir (*Abies concolor*) at higher elevations, and with small islands of red fir (*A. magnifica*) dominated forest at the highest elevations.

Methods

Survey Strategy

We used historical trapping locations, filtered sightings, and potentially suitable habitat to identify the locations to survey for martens. Historical trapping locations were identified in published interviews with local trappers in the early and mid 1900s (Stone 1904, Hemphill 1952, and Twinning unpubl. data). The MNF wildlife staff also compiled and reviewed their sightings database for marten records. They then filtered these and provided what they considered were the most plausible records. Finally, because all historical records were largely from high elevation sites with true fir (*Abies* sp.) forest, we identified the largest areas of true fir habitat were identified as locations to be surveyed.

Once the locations to survey for martens were identified, using the criteria listed above, we added as many additional locations in their vicinity that could be sampled with remaining time and equipment. Suitable habitat was identified in the field during reconnaissance conducted prior to sampling new areas. Suitable habitat was defined as large areas of conifer-dominated, late-successional forest in mesic topographic locations.

Field Methods

Track Plate

At each selected location, we established as many 4-mi^2 sample units as necessary to saturate each area. Each sample unit consisted of 6 track plate stations placed at locations with the latest successional stages and most mesic micro-sites, while maintaining a minimum of 0.8 km between station distance following the recommendations of Zielinski and Kucera (1995). Station locations were selected using a combination of field reconnaissance to assess habitat suitability and map interpretation; the location of each station was recorded using a global positioning system (Garmin, Model GPS III Plus). Once established each sample unit was visited every 3-4 days (2 intervals of each duration), to replenish bait and remove tracks, for a total of 14 consecutive days. A commercial lure, GUSTO (Minnesota Trapline Products, Pennock, MN), was placed near each station during set up and replenished on the 7^{th} survey day if neither marten or fisher had been detected.

Each track plate station consisted of a square Coroplast enclosure blocked off at one end by hardware cloth attached with zip-ties. Aluminum track plates were used with copier toner and track receptive contact paper (Zielinski and Kucera 1995). Copier toner was applied to track plates in the field and distributed evenly across plates with use of a make-up brush. Stations were baited with a drumstick-sized piece of chicken.

Hair Snares

We tested the efficacy of a new single sample hair snare, developed by N. Buckler, at as many sample units where either marten or fisher were detected. The hair snare device fits inside the standard Coroplast track plate box (Figure 2) and was deployed after the first detection.

Habitat Sampling

We sampled the structure and composition of vegetation in the vicinity of all track plate stations using a combination of variable-radius plot and transect methods. Topographic variables included elevation and presence of surface water within 250m or less. Basal area of conifers, hardwoods, and snags were estimated using the sample of trees in a 20-factor prism sweep. The tree layer, within a 0.49 ha plot (12.5 m radius) centered on each track plate station, was further described using visual estimates of canopy closure and the 5 most dominant species. Downed logs, stumps, and snags were sampled using four 25m long, 5m wide belt transects radiating out from each track plate station. Shrub species composition, and total shrub cover, was also visually estimated within the 0.49 ha plot. The total tree canopy closure was measured using a spherical densiometer and facing each cardinal direction at the station. Each site was classified according to the California Wildlife Habitat Relationships (CWHR) system to assign a habitat type, size class, and canopy cover class (Mayer and Laudenslayer 1988). All habitat sampling was done by a single individual (KMS) to minimize observer variation.

Data Analysis

We determined the sex of all marten or fisher tracks using the measurement methods and discriminant functions described in Slauson et al. (In prep). To empirically evaluate the effectiveness of our survey protocol, we estimated the probability of detection for fishers using program Presence, version 2.0 (Mackenzie and Nichols 2006). We also estimated probability of detection separately for each sex of the fisher. Program Presence uses the 'detection history' at each sample unit over the course of the 4 visits (e.g., 0101) to estimate the probability of detecting a fisher if it occurred at a minimum of 1 sample unit.

T-tests and chi-squared goodness of fit tests were used to evaluate site characteristics for locations where marten or fisher were and were not detected. Habitat characteristics were summarized using descriptive statistics (means, standard deviations, frequencies, or rank-sums).

Results

Survey Locations

We identified 4 locations that had historical records for marten occurrence. These locations were clustered around the highest peaks in the vicinity of Lake Pillsbury. They included the Snow Mountain vicinity (Dark Hollow creek, Eel river between Hull and Snow mountain), Mount Sanhedrin vicinity (near Blarney place northwest of Impassible rock, Sportsman Cabin), Hull mountain (drainage south of Boardman ridge), and Bartlett mountain. We also added all the highest elevation sites in the vicinities of these areas, including Monkey Rock (~2,000 m) and Bald mountain (2,054 m) near Hull mountain and Sheetiron mountain (~2,000 m) north of Snow mountain.

Our second priority locations included all other high elevation (>2,000 m) locations with true fir forest and locations of filtered sightings. We chose the Black Butte and Plaskett Meadows vicinity, Hammerhorn and Solomon Peak vicinity, and Buck Rock and Anthony Peak vicinity as 3 additional areas to include. The MNF wildlife staff provided 4 filtered sightings that included 2 in the Buck Rock vicinity, 1 on Kneecap Ridge, and 1 in Deer Lick Creek off the Middle Fork of the Eel River. In total, 6 first priority and 5 second priority locations were identified.

We established sample units in all but 1 first priority and 1 second priority location. Bartlett Mountain had very little mature forest remaining due to fires and logging and was not surveyed. We did not survey along the Middle Fork of the Eel River (Deer Lick Creek) due to the low elevation, lack of true fir habitat, and remoteness of this location. Mount Sanhedrin has been heavily clearcut and replanted with pine where true fir forests previously existed. We did not expend effort surveying the young pine plantations and focused on the east side of the Sanhedrin range where the largest patch of mature forest remained.

Track Plate

During the period from July 8 to September 26, 35 sample units were completed and 7 opportunistic stations in their vicinities. Seventeen species (16 mammals, 1 reptile) were detected at track plate stations (Table 1). No martens were detected at any stations. Fishers were the most frequently detected carnivore and were detected at 20 (54%) of the sample units and at 26 of 201 (13%) individual stations (Table 1, Figure 3).
Mean latency to first detection (LFD) for fishers was 8.8 days (SE = 0.80); there was a pattern in LFD by month with the July surveys having the highest mean LFD (13.0, SE = 1.0) and August-September lower mean LFD (8.3 days, SE = 3.5, 7.9 days, SE = 3.3, respectively). This trend was nearly significant ($F = 2.90$, $df = 2$, $P = 0.082$) but likely limited by small sample size in July. Using track characteristics we identified the presence of 10 male and 11 female fishers at the 20 sample units where fishers were detected. A single sex was detected at all but 1 sample unit.

The probability of detecting a fisher, given one was present, was 23.1% (SE = 0.065) for a single visit and 65% for entire 4-visit protocol used in this project. Although the single visit detection probability for male fishers (26.6%, SE = 0.09) was higher than that for females (11.0%, SE = 0.07), it was not statistically significant ($t = 1.34$, $df = 15$, $P = 0.096$). However, using the 4-visist protocol in this study, the probability of detecting a male fisher was nearly two times higher than the probability of detecting a female (71.0% versus 37.3%, respectively).

Hair Snare

We deployed hair snares following fisher detections at 10 sample units. Fishers returned to sites where hair snares were deployed in 5 of the 10 sample units and at 7 of 12 total stations. Of hair snares with fisher tracks present in front of the snare, fishers entered them on all occasions, resulting in 100% permeability. Of all entries by fishers into the hair snares, fisher hair was collected on 17 of 20 occasions, resulting in 85% effectiveness.

Habitat Characteristics at Fisher Detection Sites

The elevations of sites where track plate stations were established ranged from 653-2,234 m, with a mean of 1,615m. Fishers were detected at lower elevations (mean = 1,499 m, SE = 66.8), than sites where they were not detected (mean = 1,631, SE = 29.5); a difference that was nearly statistically significant ($t = 1.80$, $df = 32$, $P = 0.08$). Sites where fishers were detected were no more likely to be < 250 m from water than sites where they were not detected ($\chi^2 = 0.04$, $df = 1$, $P > 0.25$).

Fishers showed disproportionately higher use of Douglas-fir and Klamath mixed conifer CWHR types and lower use of montane-hardwood conifer and true fir habitats (Figure 5). However, tree species composition, based on rank dominance, was fairly similar between sites where fishers were and were not detected (Table 2). The mid- versus high-elevation distribution of fisher detections was further revealed by the lower

rank for white fir and red fir at sites where fishers were detected. Fishers were also detected at sites with more black oak and incense cedar, a mesic site indicator (Table 2).

Fishers were detected at sites with significantly higher tree canopy closure (78.1%, SE = 2.87 versus 67.6%, SE = 1.18, respectively), as estimated ocularly, ($t = 3.375$, $df = 28$, $p = 0.0024$). Shrub cover was low across all sites and did not significantly differ between sites where fishers were detected (8.9% cover, SE = 1.12) and were not detected (5.8% cover, SE = 1.46, $t = 1.68$, $df = 55$, $P = 0.09$).

Basal area of conifers was similar between detection and non-detection sites (Table 3). However fisher showed disproportionately higher use of the largest CHWR tree size classes (5 and 6) and lower use of mid-size classes (3 and 4; Figure 5). Basal area of snags was lower and hardwoods higher at sites where fishers were detected, however only the difference for hardwoods was statistically significant (Table 3). Density of medium to large snags did not differ between sites where fishers were and were not detected (Table 3). The density of medium (30-60 cm) and large (>90 cm) logs was significantly higher at sites where fishers were detected (Table 3).

Discussion

Martens

The survey protocol used in this effort is considered sufficient to detect martens when they are present. Similar protocols have been used elsewhere on a number of occasions where martens were detected (Zielinski et al. 2005, Slauson et al. 2007, Zielinski et al. 2007). Several sample units in the Yolla Bolly wilderness were rendered inoperable by bears on the majority of visits, reducing our confidence in their ability to have detected martens. However, when compared to other areas that currently support marten populations (e.g., Trinity Alps and Russian wilderness areas), the high elevations of the Yolla Bolly wilderness we sampled had very patchy forest cover, extensive barren areas, and steep elevational gradients causing rapid transitions from true fir forest types to mid-elevation mixed conifer types. These factors cast further doubt on whether a marten population could still be supported in these areas.

Based on the locations of historical marten records and our experience with marten populations elsewhere in California, we believe that the martens that once occupied the Mendocino National Forest exhibited the 'interior high-elevation' distributional pattern not the 'coastal low elevation' pattern. The high-elevation pattern is typical of marten populations occupying the Trinity-Salmon-Marble (nearest extant populations), southern Cascades, and Sierra Nevada mountains of California. The coastal pattern is exemplified by fog-influenced coastal forests, which support an assemblage of mesic shrub species forming complex structure (Slauson et al. 2007). This vegetation structure does not occur in low elevation interior forests. The interior high elevation distribution pattern largely tracks the presence of true fir forest types (e.g., Green 2007, Kirk in prep) and elevations supporting frequent winter snowfall, to which the marten is better-adapted than most other mesocarnivores (Krohn et al. 2004).

As part of a larger investigation of the relationship of high-elevation forest patches and marten population occupancy in California, we conducted an analysis of the size of high-elevation forest patches present on the MNF. The MNF is at the southern end of the interior coast range of northern California. High elevation areas become smaller and more highly fragmented as the range recedes towards Clear lake (Figure 6). Many of these high elevation patches are likely smaller than those still occupied by martens elsewhere in California. We identified high elevation patches >6,000 ft (>1,829 m) in GIS in order to estimate the number of martens that could be supported by them (Table 4). The 6,000 ft elevation cutoff was chosen because it was an important predictor of marten occurrence in the southern Cascades and northern Sierra region of California (Kirk in prep.) Although this elevation-only approach is simplistic, it does provide an opportunity to evaluate the relative size of high elevation sites likely to be the historical cores of any marten distribution on the MNF. Of these patches, only one is large enough to support a population of >25 martens, and the largest a population of 64-86 under ideal circumstances (Table 4). Such small populations can be easily extirpated and not recolonized without a nearby source population. All accounts of the historical occurrence of martens on the MNF report them as "occurring sparingly" (Twinning and Hensley 1947). Most historical records of marten occurrence come from trappers, indicating these areas were receiving trapping pressure in the late 1800s and early 1900s. Extensive poisoning efforts for coyotes, using tainted baits, also occurred on the MNF in the 1920s-1930s with unknown effects on martens but occurring concurrent with declining fisher captures by trappers (Hemphill 1952, Twinning unpubl. data). The single or combined effects of trapping and poisoning likely contributed to the decline and extirpation of historical marten populations. Furthermore, small patches of suitable habitat are vulnerable to stochastic environmental or demographic events that would make persistence difficult without a nearby source population.

Although it appears far less likely now that martens still persist on the MNF, we cannot rule out that a population may still exist in the high elevations of the Yolla Bolly Wilderness. Our survey efforts there were likely insufficient to conclude absence due to the high frequency of bear damage Although our patch analysis revealed a large amount of area >1,800 m in elevation, much of this terrain is open and rocky and lacks forest cover. Any future efforts directed towards surveys for martens on the MNF should target large areas of true fir forest in the Yolla Bolly Wilderness. Such efforts should either target seasons when bears are inactive (winter), try alternative detection devices (e.g., remote cameras with scent masking agents on camera components), or be prepared to continue surveys in locations until the sufficient number of operable survey days are achieved.

Fishers

The survey protocol used in this effort had a lower detection probability for fishers than the systematic track plate survey protocol (6-station, 16-day, 8-visit) used by Zielinski et al. (2005) conducted during the same survey months (65% versus 83% detection probability, respectively; Slauson in prep.). This low detection probability suggests that we may have missed detecting fishers at as many as 12 sample units,

although this calculation does not take into account the influence of elevation, habitat suitability, or abundance on the detection fishers and thus is likely to be overly pessimistic. Although the factors that contribute to a lower probability of detection in the summer months are not fully understood, fishers may exhibit reduced foraging distances during these months due to periods of high temperature, presence of abundant prey, and/or the continued reliance of kits on their mothers prior to the dispersal period.

The historical range of the fisher included most of the MNF, particularly locations in eastern Mendocino, western Glenn and Colusa, and northern Lake counties. Hemphill (1952) and Twinning (unpbul. data) listed Hull, Black Butte, Goat, Bald, Sanhedrin, Snow, Sheetiron, and Bartlett mountain and Lake Pillsbury vicinities as locations where fishers were trapped in the late 1800s and early 1900s. We surveyed nearly all of these locations, detecting at least one fisher in their general vicinity (Figure 3). Although we did not survey Bartlett mountain, the degraded condition of the forest there does not appear suitable to support fishers. Overall, fishers appear to be distributed throughout most of the historical range included in the geographic extent of our surveys. However, because our surveys strategically targeted the 'highest quality' habitat and there are not detailed historical records of all locations where fishers occurred on the MNF, we cannot evaluate whether or not there has been a reduction in the overall number of locations historically occupied by fishers.

The disparity between detection probabilities for male and female fishers is noteworthy and should receive additional investigation with larger samples sizes that include periods during other seasons. If this pattern holds, it may have important implications for survey protocol design and interpretation of existing, and development of future, habitat models from survey data.

The habitat results from our survey should be interpreted with caution due to the strategic process we used to select our survey locations. In general we focused on mid- to high-elevation sites with late-successional patches of mesic forest. Thus, our habitat results only apply to distinguish sites where fishers were and were not detected in that context. Given that caveat, it is not surprising that fishers were detected at sites at lower elevations and not in the immediate vicinity of water. Sites where fishers were detected had larger hardwood components, dominated by black oak, and had significantly higher canopy closure, which are recurrent findings in most studies of fisher habitat associations in California (e.g., Seglund 1995, Carroll et al. 1999, Mazzoni 2002, Davis et al. in press). Also of note were the significantly higher densities of medium to large logs at sites where fishers were detected. Large downed woody structures provide habitat for prey species (e.g., Sciurids) and resting structures (Zielinski et al. 2004).

Future survey efforts for fishers on the MNF could complement the efforts described here by surveying geographic locations and sites with habitat characteristics not covered by our efforts. Filling in the additional gaps in the survey distribution will provide a more complete picture of the current distribution of fishers on the MNF. Selecting survey locations containing contrasting habitat characteristics will allow for the full breadth of habitat used by fishers to be revealed and increase our understanding of how

fishers have responded to the natural and management induced variation in habitat suitability on the MNF.

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Literature Cited

Carroll, C., W. J. Zielinski, and R. F. Noss. 1999. Using presence-absence data to build and test spatial habitat models for the fisher in the Klamath Region, U.S.A. Conservation Biology 13:1344-1359.

Davis, F. W., C. Seo, W. J. Zielinski. In press. Regional landscape predictors of fisher (*Martes pennanti*) distribution in California. Ecological Applications.

Green, R. G. 2007. Distribution and habitat associations of forest carnivores and an evaluation of the California Wildlife Habitat Relationship Model for American marten in Sequoia and Kings Canyon National Parks. Thesis. Humboldt State University, Arcata, California, USA.

Grinnell, J., J. S. Dixon, and J. M. Linsdale. 1937. Fur-bearing mammals of California. University of California Press, Berkeley, California.

Hemphill, D. V. (1952). the vertebrate fauna of the boreal areas of the southern Yolla Bolly Mountains, California, Oregon State College**:** 234.

Kirk, T. In prep. Multiple-scale habitat modeling for American marten in northeastern California. Thesis. Humboldt State University, Arcata, California, USA.

Krohn, W. B., C. Hoving, D. Harrison, D. Phillips, and H. Frost. 2004. Martes foot-loading and snowfall patterns in eastern North America: Implications to broad-scale distributions and interactions of mesocarnivores. Pages 115-131 in: D. Harrison, A. Fuller, and G. Proulx (eds). Martens and fishers (Martes) in human altered landscapes: an international perspective. Springer Science+Buisness Media, Inc, New York, NY, USA.

Mackenzie, D. and J. Nichols 2006. Program presence version 2.0. Accessed 15 February 2007. http://www.mbr-pwrc.usgs.gov/software/doc/presence/presence.html

Mayer, K. E., and W. F. Laudenslayer. 1988. A guide to wildlife habitats of California. California Department of Forestry and Fire Protection, Sacramento, California.

Mazzoni, A. K. 2002. Habitat use by fishers (Martes pennanti) in the southern Sierra Nevada, California. Thesis. California State University, Fresno, California, USA.

Powell, R. A., S. W. Buskirk, and W. J. Zielinski. 2003. Fisher and marten (Martes pennanti and Martes americana). Pages 635–649 in G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. Wild mammals of North America: biology, management, and conservation. Second edition. The Johns Hopkins University Press, Baltimore, Maryland, USA.

Seglund, A. E. 1995. The use of resting sites by the Pacific fisher. Thesis, Humboldt State University, Arcata, California, USA.

Simon, T. L. 1980. An ecological study of the pine marten in the Tahoe National Forest. M.S. thesis. California State University, Sacramento, CA. 143 p.

Slauson, K. M., W. J. Zielinski, J. P. Hayes. 2007. Habitat selection by American martens in costal California. Journal of Wildlife Management 71(2) 000-000.

Slauson K., R. Truex, and W. Zielinski. In prep. Determining the sex of martens and fishers from foot impressions at track stations.

Slauson, K. In prep. Estimating detection probabilities for fishers in western North America using non-invasive survey protocols. Final report, U.S. Fish and Wildlife Service, Yreaka, CA.

Spencer, W. D., R. H. Barrett, et al. 1983. Marten habitat preferences in the northern Sierra Nevada. Journal Wildlife Management 47(4): 1181-1186.

Stone, W. 1904. On a collection of birds and mammals from mount Sanhedrin, California. Proceedings of the Academy of Natural Sciences of Philadelphia. Volume LVI: 576-585.

Twinning, H. and A. Hensley. 1947. The status of pine martens in California. California Fish and Game 33:133-137.

Twinning, H. Unpublished data. Field notes, California Department of Fish and Game.

USDI Fish and Wildlife Service. 2004. 12-month finding for a petition to list the west coast distinct population segment of the fisher (*Martes pennanti*). Federal Register 69(68):18770-18792.

Zielinski, W.J. and T.E. Kucera. 1995. American marten, fisher, lynx and wolverine: survey methods for their detection. General Technical Report PSW-GTR-157. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 163pp.

Zielinski, W.J., K. M. Slauson, C. R. Carroll, C. J. Kent, and D. K. Kudrna. 2001. Status of American marten populations in the coastal forests of the Pacific States. Journal of Mammalogy 82: 478-490.

Zielinski, W. J., R. L. Truex, F. V. Schlexer, L. A. Campbell, and C. R. Carroll. 2005. Historical and contemporary distributions of carnivores in forests of the Sierra Nevada, California, USA. Journal of Biogeography 32: 1385-1407.

Zielinski, W. J., K. M. Slauson, A. E. Bowles. 2007. The effect of off-highway vehicle use on the American marten in California, USA. Final report submitted to USDA Forest Service, Pacific Southwest Region. USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, Arcata, CA.

Table 1. Species detected using enclosed sooted track plates on the Mendocino National Forest in 2006.

Species	Sample Units (n = 35)	Stations (n = 201)
Carnivores		
Fisher	20 (54%)	26 (13%)
Male	10 (27%)	12 (6%)
Female	11 (30%)	14 (7%)
Gray Fox	9 (24%)	14 (7%)
Bobcat	2 (5%)	3 (1%)
Western spotted Skunk	11 (30%)	18 (9%)
Striped Skunk	1 (3%)	1 (<1%)
Ringtail	8 (22%)	10 (5%)
American Black Bear	14 (38%)	20 (10%)
American Opossum	1 (3%)	1 (<1%)
Rodents		
Northern Flying Squirrel	2 (5%)	2 (1%)
Dusky-footed Woodrat	16 (43%)	37 (18%)
Douglas Squirrel	8 (22%)	13 (6%)
Golden-mantled Ground Squirrel	9 (24%)	13 (6%)
California Ground Squirrel	6 (16%)	10 (5%)
Western Gray Squirrel	1 (3%)	1 (<1%)
Chipmunk Sp.	12 (32%)	15 (7%)
Mice Sp.	28 (76%)	50 (25%)
Other		
Lizard Sp.	13 (35%)	23 (11%)
Unknown	2 (5%)	2 (1%)

Table 2. Rank dominant tree species (A) and California Wildlife Habitat Relationships system (CWHR) habitat types at stations where fishers were and were not detected on the Mendocino National Forest in 2006.

A. By dominant tree species.

Rank	Non-detection	Fisher Detection
1	White fir	Douglas-fir
2	Douglas-fir	White fir
3	Red fir	Ponderosa pine
4	Ponderosa pine	Black oak
5	Sugar pine	Incense cedar
6	Black oak	Sugar pine

B. By dominant CWHR type.

Rank	Non-detection	Fisher Detection
1	White fir	Douglas-fir
2	Red fir	Klamath Mixed Conifer
3	Klamath Mixed Conifer	White fir
4	Douglas fir	Red fir
5	Montane Hardwood Conifer	Montane Hardwood Conifer

Table 3. Habitat characteristics at stations where fishers were, and were not, detected on the Mendocino National Forest in 2006. Means and standard errors, in parenthesis are presented.

Variable	Non-detection	Fisher Detection	*t*-statistic	df	P-value
Basal Area					
Conifer	208.3 (8.60)	190.4 (24.8)	0.68	30	0.50
Hardwood	14.7 (3.15)	36.0 (12.9)	1.60	26	0.05
Snag	41.7 (3.64)	28.0 (8.17)	1.44	32	0.15
Snag Density (#/ha)					
cm DBH*					
30-60	5.97 (0.71)	4.58 (2.55)	0.52	26	0.60
60-90	3.90 (0.55)	2.91 (1.53)	0.60	29	0.54
>90	1.77 (0.38)	1.25 (0.91)	0.52	26	0.60
Log Density (#/ha)					
cm max. diameter					
30-60	11.30 (1.01)	12.50 (2.01)	0.57	35	0.59
60-90	5.85 (0.61)	9.58 (2.65)	1.36	25	0.08
>90	1.47 (0.32)	3.33 (1.15)	1.55	26	0.06

*DBH = diameter at breast height

Table 4. Density estimates for American martens in high-elevation (>1,820 m) patches assuming two home range size alternatives (small = 250 ha, large = 500 ha), and under three habitat saturation (satur) scenarios. Patch numbers refer to those in figure 6.

		250 ha per 1 male & 1female			500 ha per 1 male & 1female		
Patch #	Size (ha)	100% Satur.	75% Satur.	50% Satur.	100% Satur.	75% Satur.	50% Satur.
1	2839	23	17	11	11	9	6
2	431	3	3	2	2	1	1
3	10711	86	64	43	43	32	21
4	497	4	3	2	2	1	1
5	1440	12	9	6	6	4	3
6	1375	11	8	6	6	4	3
7	2115	17	13	8	8	6	4
8	1147	9	7	5	5	3	2
9	1260	10	8	5	5	4	3
10	667	5	4	3	3	2	1
11	2183	17	13	9	9	7	4

Figure 1. Locations of track plate stations sampled during July-September 2006 on the Mendocino National Forest.

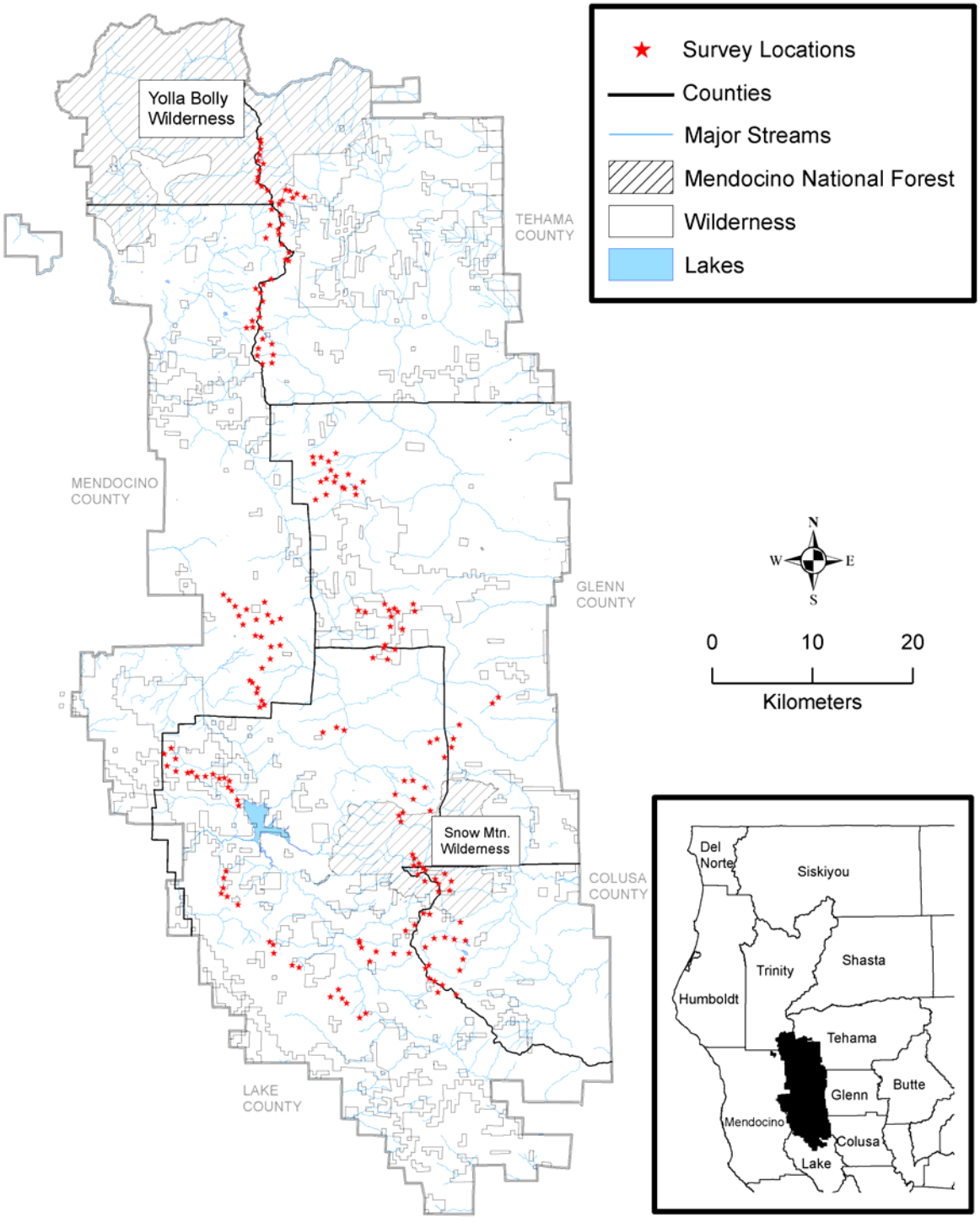


Figure 2. Single sample hair snare placed in the entrance of a coroplast track plate box (above) and fisher tracks and hair (below) collected on the Mendocino National Forest in 2006.

Figure 3. Locations of track plate stations and fisher detections, sampled during July-September 2006 on the Mendocino National Forest.

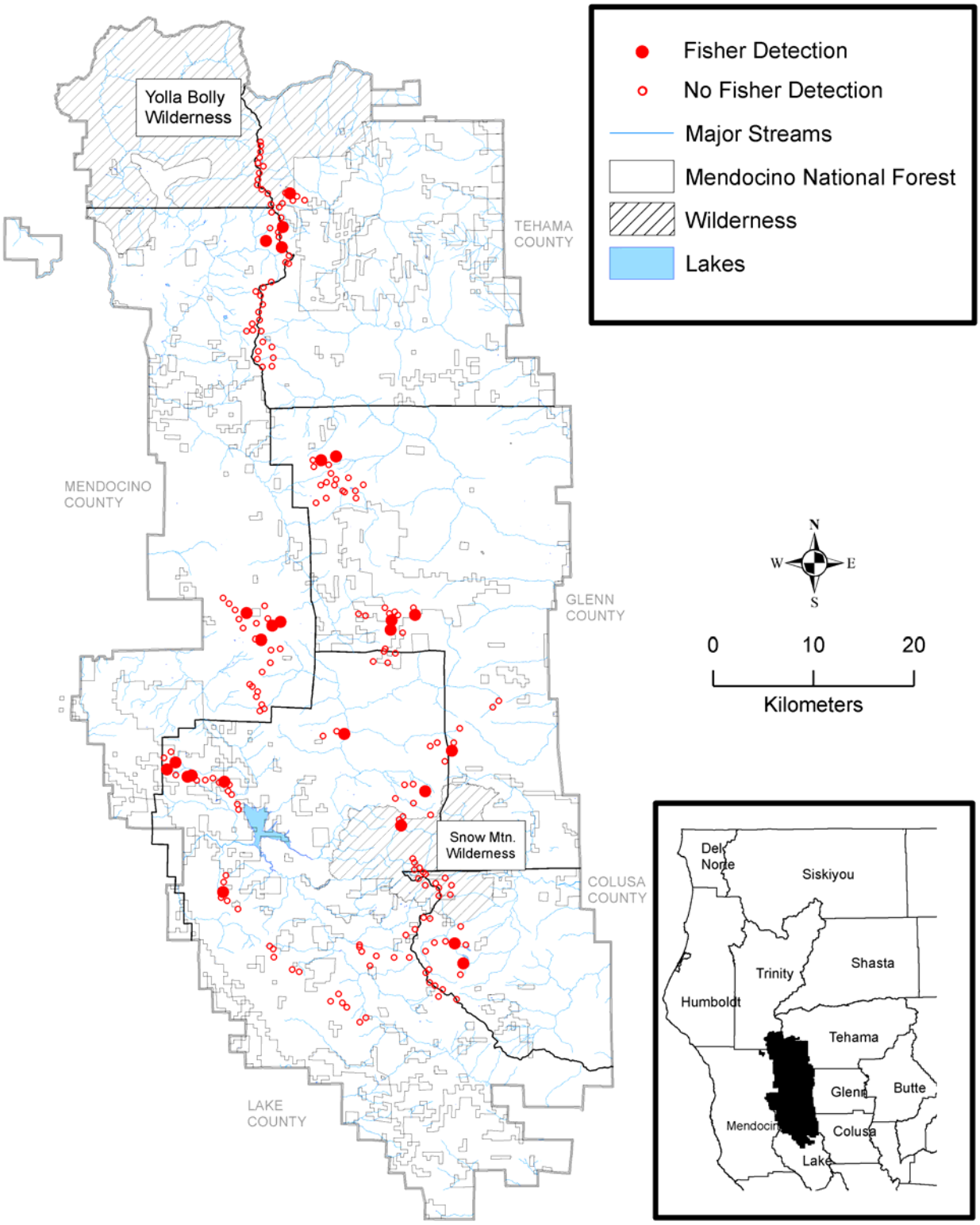


Figure 4. Locations where male and female fishers were detected at track plate stations sampled during July-September 2006 on the Mendocino National Forest.

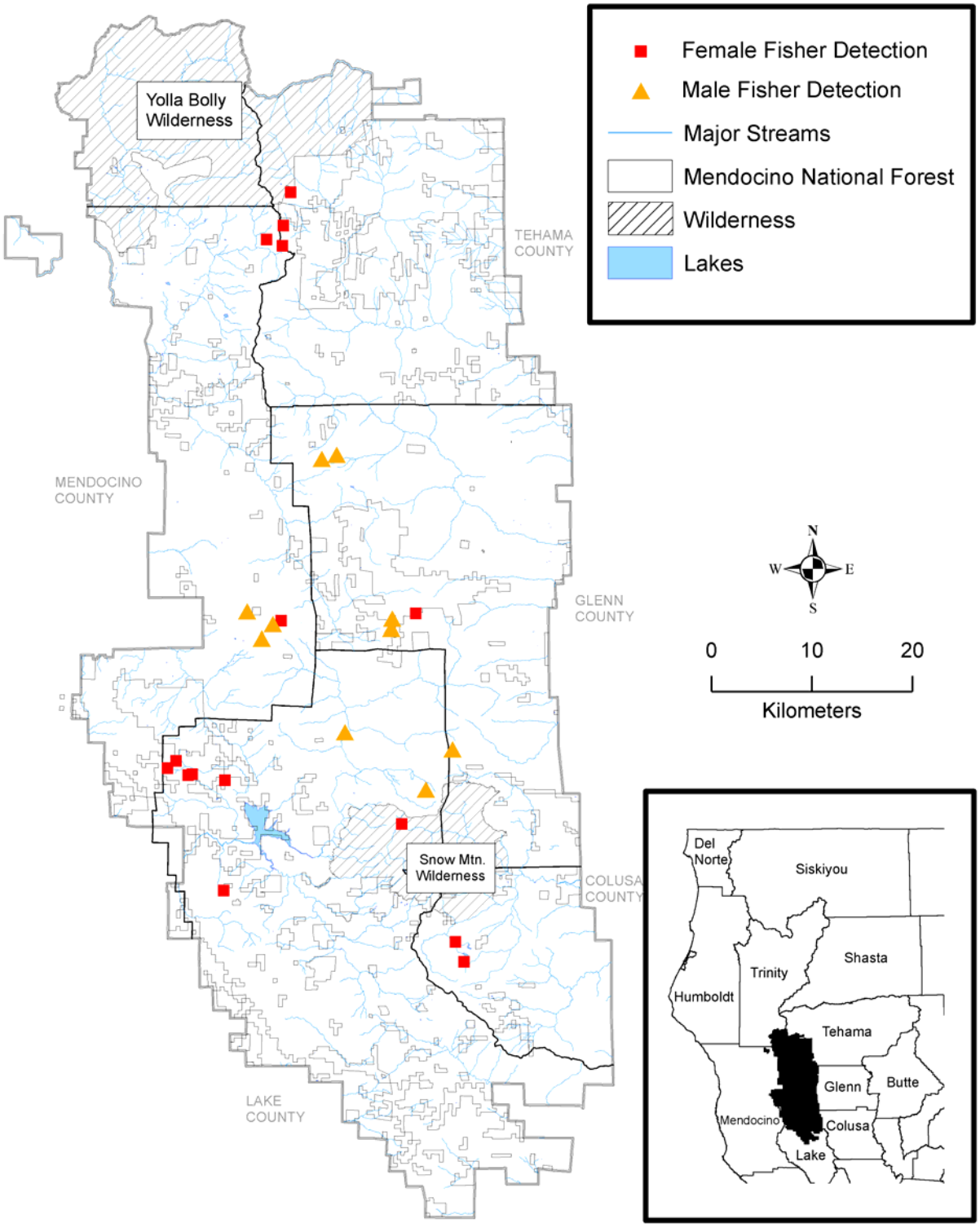
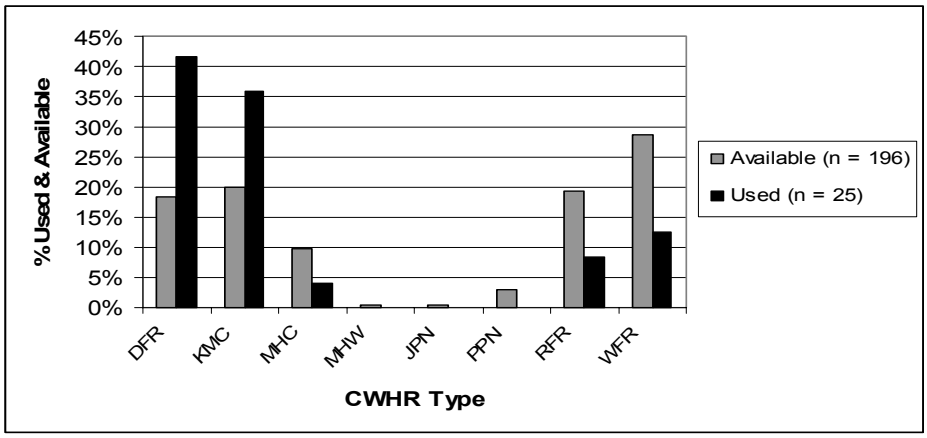
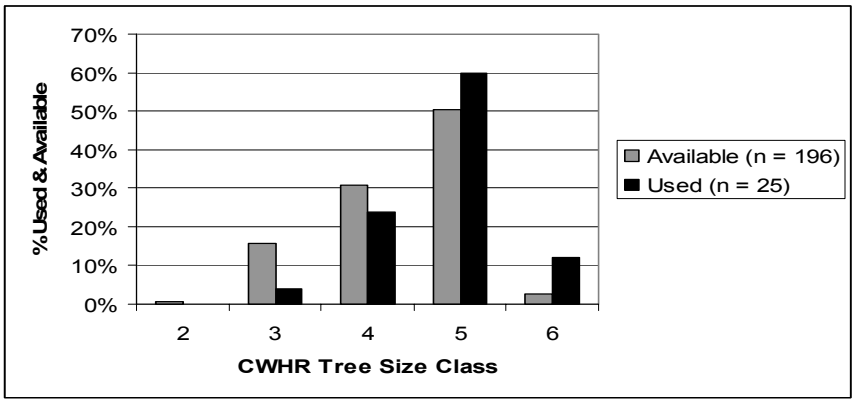


Figure 5. California Wildlife Habitat Relationship (CWHR) characteristics for all sites sampled (available) and those where fishers were detected (used) using track plates from July-September 2006 on the Mendocino National Forest.

5a. CWHR Habitat Type.



5b. CWHR Tree Size Class.



5c. CWHR Tree Canopy Closure.

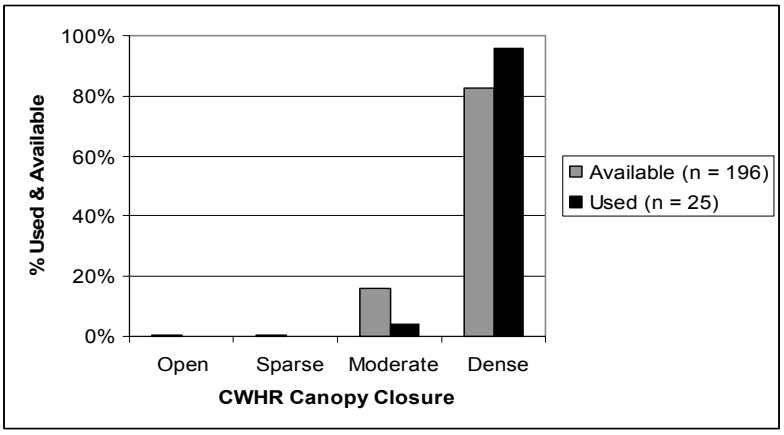


Figure 6. Relative size and distribution of high elevation (>1,829 m) patches on the Mendocino National Forest. Patches 3, 6-11 were sampled with ≥ 2 track plate sample units in 2006.